In Plate X, figure 2 reproduces them as they appeared September 13th. The line drawn between them indicates the position of the Sun's equator. The north spot was then 30,000 miles in diameter, the south one 26,000 miles. The distance between their centers was 33,000 miles, leaving a space of but 5000 miles between the edges of their penumbras. The field-strength at the center of the north spot was 3200 gausses and at the center of the south spot 3000 gausses, but of opposite sign.

From the behavior of these spots it would seem as if there must have been some condition which prevented them from crossing the equator, otherwise one would have expected the two spots to drift together instead of the larger drifting toward the smaller. At any rate they illustrate remarkably the difference in polarity of sunspots on opposite sides of the Sun's equator.

SETH B. NICHOLSON.

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NOTE ON A SENSITIVE SPECTROGRAPHIC ARRANGEMENT

The great light-gathering power of the 100-inch telescope, the freedom from chromatic aberration, the long focal length, and the consequent slow convergence of light at the secondary focus, make it possible to develop a simple and effective device for obtaining the spectral types and absolute magnitudes of extremely faint stars in crowded regions (such as globular or open clusters), as well as of faint isolated objects in general. The faintness to which our greatest instruments can carry spectroscopic researches is definitely limited so long as we demand sufficient dispersion and definition to permit extended analyses of lines in stellar spectra or desire to use spectroscopes largely for accurate determinations of radial velocity. This working limit can be considerably extended if we sacrifice dispersion and accuracy in radial velocity measures; and, if we are willing to forego altogether the velocities (uncertainly determined with one of these small-dispersion spectroscopes) and to aim at the derivation of spectral types alone, we may do away with the slit, which is generally very wasteful of light, and lower still farther the magnitude limit.

Recent experiment at the secondary focus of the 100-inch reflector with an especially rapid, slitless, focal-plane spectroscope gives in a five-minute exposure the spectral type of twelfth magnitude stars. In clusters, as many as thirty stars were photographed at one time, but the scale is reduced to one-sixth the original at

that focus, with consequent confusion in dense regions. Notwithstanding the loss in dispersion and definition, on such plates most types show sufficiently clear absorption lines for spectral identification; there is little hope, however, of obtaining on such low dispersion absolute magnitudes from spectral lines. But the absorption lines are not the only criteria of spectral type and absolute luminosity, and in attempting to push as far as possible our knowledge of these properties in star clusters, it becomes evident that if we can so adjust our problem that the definition and dispersion necessary to retain spectral lines become unimportant, we may considerably extend the magnitude limit by eliminating some other light-wasting optical parts of the spectroscope.

The obvious solution of the problem is to do away with collimating and camera lenses altogether, and substitute for the thick, large-angled prism of the spectroscope a thin, small-angled prism, placing the latter not back of the focus of the telescope but in the slowly converging beam. With plates properly sensitized the spectrum may be photographed thruout the interval from less than 4000 A to greater than 7000 A, with a sharp break in the green, which affords a constant reference point and readily permits the comparison, visual or microphotometric, of the extent and intensities of the red and blue divisions.

With a prism of 6° angle and 12 inches clear aperture, mounted 20 inches in front of the plate-holder, preliminary photographs of the open cluster Messier 11 have been made with the 100-inch telescope. An exposure of 20 minutes on an ammoniated Wratten M plate gives the spectra of more than 250 stars with photographic magnitudes from 12 to 14. Seed 30 plates, dyed with pinacyanol, appear to be much faster, but the dividing segment may not be as efficient. The field satisfactorily covered is about 4.5 inches= 8′ in radius. For stars of color index +1.6, the red division of the spectrum is about three times as intense as the blue; for stars of color index +0.2, the blue division is some five times as intense as the red.

Advantages of this spectroscopic arrangement are:

(1) It appears to be much faster than the most rapid focal-plane spectrograph now in use, and covers at least five times the angular field.

(2) It utilizes to full extent the scale of the 100-inch telescope, permitting close investigation of the centers of clusters.

(3) It requires the development of criteria for spectral type and absolute magnitude that make use of a much greater interval of wave-length and particularly of the neglected red end of stellar spectra.

(4) The relatively slower speed of photographic plates in the red is offset by the prismatic concentration, so that for G-type stars the two divisions are of comparable intensity.

(5) The small demands on definition permit the use of this arrangement during unfavorable conditions of seeing.

HARLOW SHAPLEY.

## METCALF'S FIRST COMET

Metcalf's first comet was photographed September 15 with the 10-inch triplet at Mount Wilson. An exposure of one hour, from 7:14 to 8:14 P. S. T., showed the comet as a round nebulosity about 12 minutes of arc in diameter with a faint tail, three and a half or four degrees long, in position angle 22 degrees. The comet was much condensed toward the center but showed no stellar nucleus. The tail left the head as a very narrow ray which spread but little as it receded, reaching a width of about 6 minutes of arc at a distance of two and a half degrees. At this point it spread out abruptly on the northwest side to a width of 20 minutes near the extreme end. Half a degree from the head there was a faint ray about one degree long extending to the northwest, making an angle of about five degrees with the main tail.

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## NOVAE IN THE ANDROMEDA NEBULA

No. 14, discovered by Miss Ritchie, 290″ east, 180″ south of nucleus, near edge of bright, soft nebulosity, appears on plates of 1919, July 21st and 23rd, by Shapley, and on those of July 28th and 29th, by Duncan.

ESTIMATED MAGNITUDES OF NO. 14

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|---|---|
| July 21 | 15.9 |
| 23 | 15.9 |
| 28 | 16.0 |
| 29 | 16.1 |
| Aug. 24 | >18.5 (invisible) |

No. 15, discovered by Duncan, 160″ west, 170″ north of nucleus, about 1′ southwest of Nova No. 12, in large curdled area of the